Paper ID: 111
Theme 3. Sustainability of grasslands- social and policy issues
Sub-theme 3.3. Sustainable use of grassland resources

Fodder yield and quality of Egyptian clover (*Trifolium alexandrinum* L.), annual ryegrass (*Lolium multiflorum* Lam.), and barley (*Hordeum Vulgare* L.) monocultures as affected by organic and mineral fertilization

Heba Sabry Attia Salama
Faculty of Agriculture - Alexandria University, Alexandria, Egypt
Corresponding author e-mail: heba1942001@yahoo.com

Keywords: Annual ryegrass, Barley, Egyptian clover

Introduction

Egyptian clover (*Trifolium alexandrinum* L.) is the most important forage legume crop in Egypt. Despite the fact that its yield and protein content are high, it is characterized by low dry matter content especially in the 1st cut, in addition to its limited energy supply, attributed to the low carbohydrate content. Therefore, there is a pressing need to introduce some promising winter annual forage grasses, like barley (*Hordeum vulgare* L.) and ryegrass (*Lolium multiflorum* L.), and investigate their performance under the Egyptian agricultural conditions. This would enhance the Egyptian animal production systems by providing a high-quality feed at low cost. As nitrogen (N) fertilization is a key input in the Egyptian agricultural system, the introduction of high-yielding genotypes would greatly increase the prospect of increasing yields, but this goal will not be reached without appropriately managing the N fertilizer application. Besides, organic farming is receiving increased attention nowadays. Therefore, main aim of the current study was to investigate the yield and quality of the three tested forage species under varying levels of organic, as well as N fertilizers.

Materials and Methods

Field trials were conducted during the winter seasons of 2012 and 2013, at two locations in Egypt, first trial at SEKEM organic farm, and second trial at the experimental farm of the faculty of agriculture, Alexandria University. A split plot design, with three replicates, was used for the two trials. In the 1st trial, three forage cultivars, namely; Egyptian clover (EC), annual ryegrass (RG) and barley (B) were evaluated under two organic fertilizer treatments; compost and poultry litter, and a control treatment (no fertilizer). In the 2nd trial, the same three forage cultivars were evaluated under three N fertilization levels (72, 107, and 143 kg ha^{-1}). Main plots were assigned to test the fertilizer applications, while, the forage cultivars were tested in the subplots. Compost was produced in open windrows and sourced mainly from animal manure (35%) and plant residues (65%). Whereas, poultry litter was prepared from pure chicken manure. Nitrogen was applied in the form of ammonium nitrate (33% N). All the forage cultivars were drilled with the recommended seeding rate, amounting to 40 kg ha^{-1} for both EC and RG, and 80 kg ha^{-1} for B. Plot size in both trials was 3 × 2.4 m. All plots were treated similarly. First cut was taken at 60 days after sowing. Plots were manually harvested to a 5-cm stubble height and the fresh herbage per plot was weighed in the field. A representative sub-sample of approximately 500 g fresh matter per plot was dried to determine the dry matter (DM) content. Fodder quality was investigated, represented by the concentrations of neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL), using the method of Van Soest *et al*. (1991). Crude protein (CP) content was traditionally analyzed by the Kjeldahl procedure (AOAC, 1990), and carbohydrate content was determined using the phenol-sulfuric acid method as described by DuBois *et al*. 1956. Data were statistically analyzed using the mixed procedure of SAS, with the least significant difference (L.S.D.) procedure for mean comparison. Data from the two growing seasons were combined because the test of homogeneity of variance was non-significant.

Results and Discussion

Analysis of variance for both trials revealed significant variation ($P < 0.001$) among the three tested monocultures for all the studied parameters. While, the fertilizer applications caused significant variations ($P < 0.01$) only in the yield, DM and CP contents, in the 1st trial, and the yield and CP content, in the 2nd trial. Interaction between the two studied factors was non-significant in both trials.

Cultivar-related effects: Means of the three cultivars for all the tested parameters, presented in Table 1, demonstrate that the direction of the variation among the three cultivars was the same in case of the two trials. Where, B monoculture produced the highest significant yield, DM, NDF, and ADF contents in both experiments, with values amounting to, 9.56 (ton ha^{-1}), 180.58, 576.27, 353.09 (g kg^{-1}), respectively, for the 1st trial. While in the 2nd trial the values of the four respective parameters were, 11.26 (ton ha^{-1}), 177.00, 563.47, and 327.45 (g kg^{-1}). Contrarily, the EC produced the highest significant CP and ADL contents, in both trials, with CP content amounting to 171.23 and 155.52, (g kg^{-1}) for the 1st and

2nd trials, respectively. In addition, RG was significantly superior only in case of the carbohydrate content, with 258.99, and 273.00 (g kg^{-1}) for the 1st and 2nd trials, respectively.

Fertilization-related effects: The fertilizer levels caused significant variations only in case of yield, and CP contents in both trials and in case of DM content only in the 1st trial. Means presented in Table 2 revealed that, in the 1st trial, application of poultry litter resulted in significantly increasing the 1st cut yield up to 9.19 ton ha^{-1}. In addition, the same treatment accumulated the highest significant CP content, amounting to 145.67 g kg^{-1}. These results might be attributed to the correction of N deficiency and, thus, improved soil properties upon poultry litter application. It was also reported that nitrogen concentration in plant tissues increased with poultry litter application. In the 2nd trial, increasing the N fertilizer level from 72 to 143 kg N ha^{-1}, significantly increased the fodder yield and CP content up to 11.02 ton ha^{-1} and 132.77 g CP kg^{-1}. The higher crude protein at higher nitrogen levels was mainly due to structural role of nitrogen in building up amino acids. The progressive increase in crude protein contents with increasing nitrogen rates was documented.

Table 1: Variations in the 1st cut yield (ton ha^{-1}) and quality parameters (g kg^{-1}) among the tested cultivars in the 1st and 2nd trials.

	Yield	DM	CP	Carbohydrate	NDF	ADF	ADL
Trial 1:							
EC	7.70 b	123.27 c	171.23 a	154.26 c	416.55 c	236.32 c	39.29 a
RG	6.96 b	153.01 b	131.73 b	258.99 a	466.91 b	316.36 b	19.66 b
B	9.56 a	180.58 a	120.65 c	236.49 b	576.27 a	353.09 a	23.58 b
$L.S.D._{0.05}$	1.83	6.75	5.83	18.67	21.49	8.64	4.16
Trial 2:							
EC	9.11 b	120.59 c	155.52 a	170.89 c	399.23 c	217.58 c	43.86 a
RG	7.95 b	155.08 b	116.94 b	273.00 a	505.74 b	279.60 b	18.22 b
B	11.26 a	177.00 a	110.12 c	234.09 b	563.47 a	327.45 a	20.14 b
$L.S.D._{0.05}$	1.96	5.53	4.01	20.31	17.99	6.98	2.04

Means with different small letter(s) are significantly different according to the L.S.D. test at 0.05 level of probability.

Table 2: Variations in the 1st cut yield (ton ha^{-1}) and quality parameters (g kg^{-1}) among the tested fertilizer applications in the 1st and 2nd trials.

	Yield	DM	CP	Carbohydrate	NDF	ADF	ADL
Trial 1:							
Control	6.46 b	147.49 b	133.15 b	211.78 a	479.26 a	299.12 a	28.14 a
Compost	8.56 a	149.80 ab	144.78 a	221.04 a	486.02 a	304.52 a	26.95 a
Poultry litter	9.19 a	159.58 a	145.67 a	216.92 a	494.46 a	302.12 a	27.44 a
$L.S.D._{0.05}$	2.01	10.84	6.78	14.37	19.64	6.45	3.98
Trial 2							
72 kg N ha^{-1}	8.43 b	151.98 a	123.73 b	230.80 a	484.72 a	274.76 a	26.33 a
107 kg N ha^{-1}	8.87 b	149.67 a	126.09 b	225.33 a	487.91 a	273.03 a	27.20 a
143 kg N ha^{-1}	11.02 a	151.02 a	132.77 a	221.84 a	495.81 a	276.85 a	28.70 a
$L.S.D._{0.05}$	2.04	6.99	6.54	17.64	14.26	4.92	2.47

Means with different small letter(s) are significantly different according to the L.S.D. test at 0.05 level of probability.

Conclusion

The obtained results indicated significant variations in the yield and tested quality parameters among the three forage monocultures. EC was superior in the CP content, while the forage grasses produced highest yield, DM, carbohydrates and fiber fractions. Organic, as well as mineral fertilizer applications exerted a significant influence on the yield, DM and CP contents. Highest values were achieved with application of poultry litter (1st trial) and highest nitrogen level (2nd trial). These results suggest that mixing the EC with the tested forage grasses would improve the forage yield and quality of the 1st cut. It is recommended to investigate the yield and quality of different grass-legume mixtures under organic and mineral fertilizer applications.

References

A.O.A.C.1990. *Official Methods of Analysis* (15th Ed.). Association of Official Analytical Chemists. Arlington, VA.

DuBois, M., K. Gilles, J. Hamilton, P. Rebers and F. Smith. 1956. Colorimetric method for determination of sugars and related substances. *Anal. Chem.*, 28: 350-356.

Van Soest, P.J., J. B. Robertson and B. A. Lewis. 1991. Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. *J. Dairy Sci.* 74: 3583-3597.